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Study of Profile of Rodenticide Poisoning in a Tertiary Care Hospital

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ABSTRACT

Background: Rodenticide poisoning is a major cause of poisoning-related deaths in our country, largely due to the lack of a specific antidote. This underscores the need for a thorough study of its clinical spectrum and associated mortality. Early identification of rodenticide compounds and prompt management of complications are crucial to reducing mortality and improving patient outcomes. **Objectives:** Evaluate the clinical profile and clinical outcomes of patients admitted for rodenticide poisoning in McGann tertiary care hospital's general medicine department. **Methods**: Methods: A total of 210 cases of rodenticide poisoning admitted to McGann Tertiary Care Hospital over a 12-month period (January 2021 to December 2021) were included in the study based on specified inclusion and exclusion criteria. For each patient, medical history and clinical features were recorded, followed by a thorough physical examination and relevant investigations. Data were systematically collected using a structured proforma after obtaining informed consent from the patients. Statistical analysis was conducted using SPSS software to assess the findings. **Results:** In our study, majority (48.10%) of the study participants were in the age group 21-30 years. Most common rodenticide used was Yellow phosphorous (80%), followed by zinc phosphide (15.2%). Zinc phosphide constitutes 15.2% of cases with a high mortality of 25%. Yellow Phosphorus poisoning has a mortality of 9.5%. Bromadiolone poisoning cases had no deaths. We observed mortality increased with delay in time to presentation after ingestion and with increase in the amount of substance consumed. **Conclusion:** The study highlights the burden of rodenticide poisoning mortality and need to emphasize on early intervention, improving public awareness regarding their lethality and monitoring of sales and usage of rodenticides to avoid indiscriminate use and poisoning.

INTRODUCTION

Human poisoning frequently occurs due to exposure to chemicals commonly found in households, including insecticides, pesticides, and rodenticides. These substances are readily accessible and can pose significant health risks when misused or ingested accidentally. While organophosphorus compounds are widely recognized as a leading cause of poisoning, rodenticides-often referred to as "rat poisons" also play a major role. Rodenticides are specifically formulated to control the population of pests such as rats, mice, squirrels, and gophers. These animals not only present health risks by spreading diseases but also threaten food security and property by destroying crops and damaging infrastructure. Due to their rapid reproductive rateS and highly destructive behaviors, these pests can quickly become overwhelming if left unchecked, making rodenticides a critical tool in pest management. However, their toxic nature underscores the need for caution in handling and storage to prevent accidental poisoning in humans [1-2].

In India, rodenticide poisoning is predominantly intentional, with a high prevalence of suicidal cases rather than accidental exposures. The choice of rodenticides has evolved over time; in the past, arsenic and other heavy metals were commonly used, but in recent decades, anticoagulants have become the primary agents for rodent control. Introduced in the 1950s, anticoagulant rodenticides transformed pest management by offering distinct ad-

-vantages over traditional, fast-acting poisons. These anticoagulants work gradually, allowing rodents to consume multiple doses without immediate symptoms, leading to a cumulative toxic effect that eradicates infestations discreetly and effectively. Another benefit is that birds, which may inadvertently consume bait, have a higher tolerance to anticoagulants, while most mammals, though susceptible, typically require several ingestions for a lethal outcome. Importantly, the antidote for anticoagulant poisoning, vitamin K1, can effectively counteract toxic effects when administered in time, significantly reducing the risk of fatality from accidental exposure. This development has made anticoagulant rodenticides not only a practical solution for pest control but also a safer option in cases of unintended ingestion, particularly when compared to older, more immediately toxic rodenticides [3-5].

In rural India, poisoning constitutes a significant portion of emergency health care, with rat or rodenticide poisoning being the second most ingested poison after organophosphorus compounds. Rodenticides in India include zinc phosphide, yellow phosphorus, and super warfarins. Rodenticide poisoning affects nearly every system and ranges from asymptomatic to life-threatening, particularly in children who frequently ingest these substances orally [6-8, 12].

Children are the most common victims of rodenticide poisoning, presenting symptoms such as hematuria, hemoptysis, epistaxis, flank pain, easy bruising, and petechiae. Adults attempting suicide also contribute to cases, emphasizing the critical need to identify the consumed substance, as toxicity depends on the amount ingested. With no specific antidote, rodenticide poisoning has a high mortality rate due to diverse compounds with varying mechanisms, clinical profiles, and fatality rates [9-11]. Zinc phosphide is identified as the most frequently used chemical in household rodenticides. Early indicators of toxicity include temporary heart rate irregularities, metabolic acidosis, fever, and leukocytosis, and these symptoms should be monitored in all suspected cases. It is essential to raise awareness about the hazardous effects of rodenticides among the general public, as well as among medical and paramedical professionals [12-13].

Given the limited research on rodenticide poisoning, this study underscores the importance of understanding clinical outcomes and early identification of complications to mitigate mortality risks. The primary objective of this study is to assess the clinical profile and outcomes of patients admitted with rodenticide poisoning to the General Medicine department of McGann Tertiary Care Hospital. This evaluation aims to gain insights into the range of clinical presentations, complications, and recovery patterns associated with rodenticide poisoning, contributing to improved understanding and management of such cases within the hospital setting.

MATERIAL AND METHODS

This cross-sectional study included non-diabetic patients over 13 years old with rodenticide poisoning admitted to McGann District Teaching Hospital, Shivamogga, from January to December 2021. Ethical approval has been obtained from the ethical approval committee. Exclusions were chronic liver disease, anticoagulant use, bleeding disorders, and mixed poison ingestion. After informed consent, data were collected on demographics, symptoms, and poisoning details. Patients underwent a thorough examination, with investigations including hemogram, renal and liver function tests, electrolytes, PT, APTT, INR, chest X-ray, ECG, and additional tests if needed.

Statistical Analysis and Methods

Data was collected using a structured proforma and entered into an MS Excel sheet, then analyzed with SPSS version 24.0 (IBM, USA). Qualitative data was expressed as proportions, while quantitative data was presented as mean and standard deviation. The association between two qualitative variables was assessed using the Chi-square or Fisher's exact test. Mean and SD comparisons between groups were conducted using an unpaired t-test to evaluate the significance of mean differences. Descriptive statistics for each variable were reported as mean, standard deviation, and standard error of the mean. A p-value <0.05 was deemed statistically significant, and a p-value <0.001 highly significant.

RESULTS

This study aims to assess the clinical profile and outcomes of patients admitted with rodenticide poisoning to the General Medicine department at McGann Tertiary Care Hospital. In our findings, the majority of participants (48.1%) were aged 21-30 years, followed by 30% under 20 years. The mean age was 25.84 ± 8.75 years. Of the 210 participants, 90% were male, and 10% were female, with the majority (58.6%) being married.

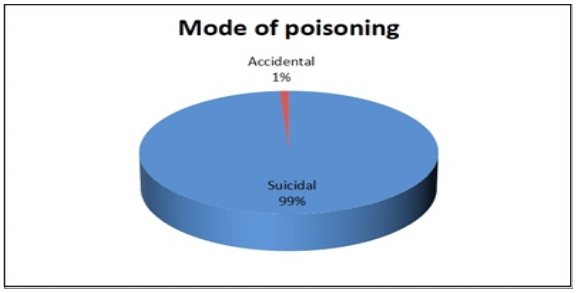

Figure 1: Distribution According to Mode of Poisoning

The pie chart shows that the overwhelming majority (99%) of poisoning cases were intentional (suicidal), while only 1% were accidental. This indicates that suicidal intent is the primary cause of rodenticide poisoning incidents in the studied population.

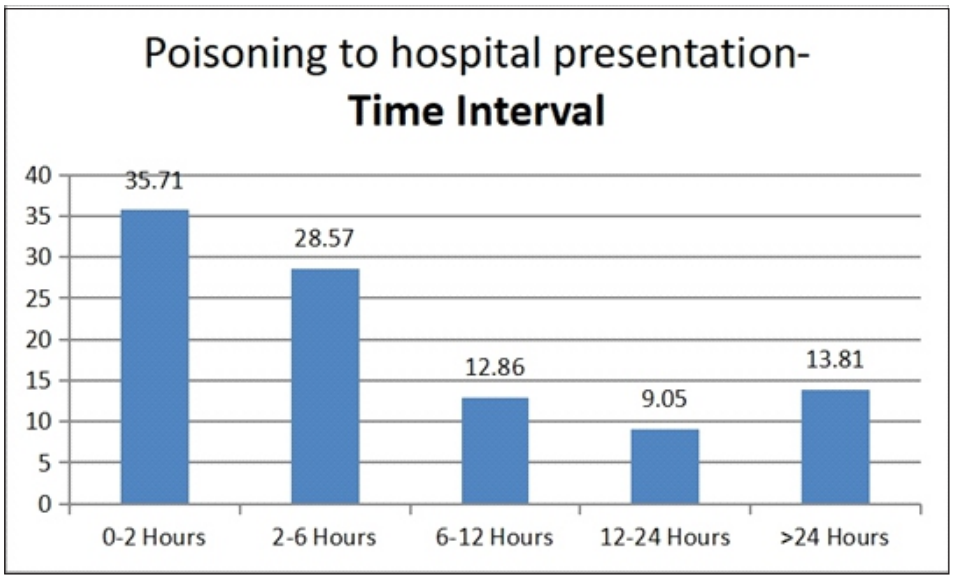

Figure 2: Distribution According to Poisoning to Hospital Presentation- Time Interval

In figure 2 illustrates the time intervals between rodenticide poisoning and hospital presentation among patients. Most patients (35.71%) arrived at the hospital within 0-2 hours of poisoning, followed by 28.57% who arrived between 2-6 hours. A smaller percentage presented after 6-12 hours (12.86%) and 12-24 hours (9.05%), with 13.81% arriving over 24 hours post-poisoning. This distribution highlights the urgency and promptness of medical response in acute poisoning cases.

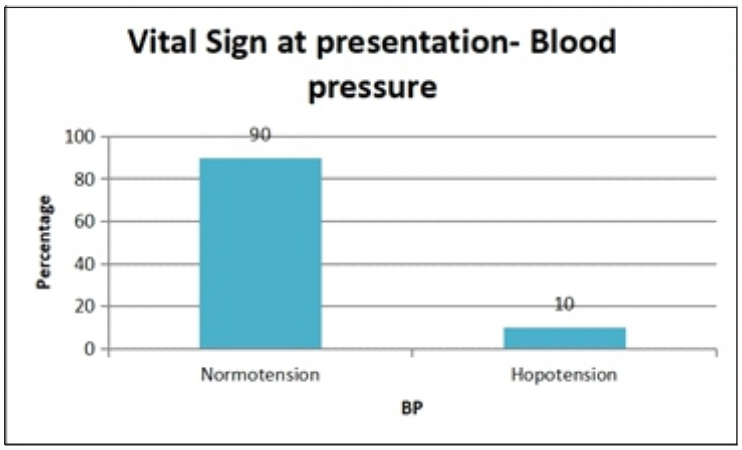

Figure 3: Vital Signs at presentation- Blood Pressure

The data indicates that, out of 210 participants, a majority (90%) presented with normal blood pressure (normotension) at admission, while none were hypertensive. However, 10% of the participants were hypotensive, suggesting a small subset with low blood pressure among the poisoned patients.

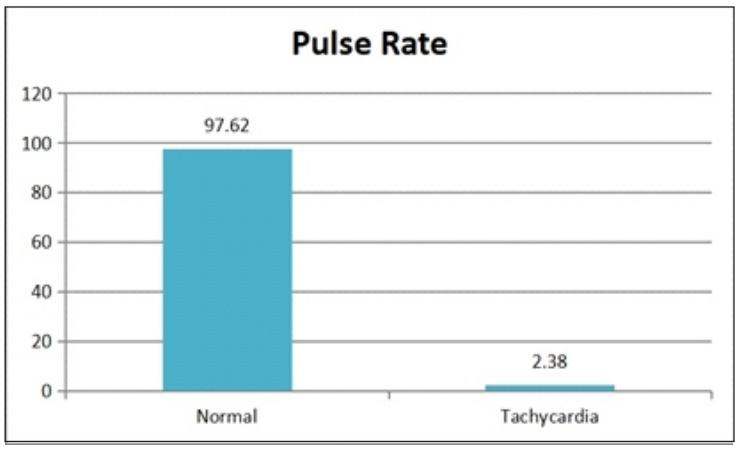

Figure 4: Vital Signs at Presentation- Pulse Rate

The data shows that the vast majority (97.62%) of participants had a normal pulse rate upon presentation, with only 5 individuals experiencing tachycardia. This suggests that abnormal pulse rates were rare among the studied group.

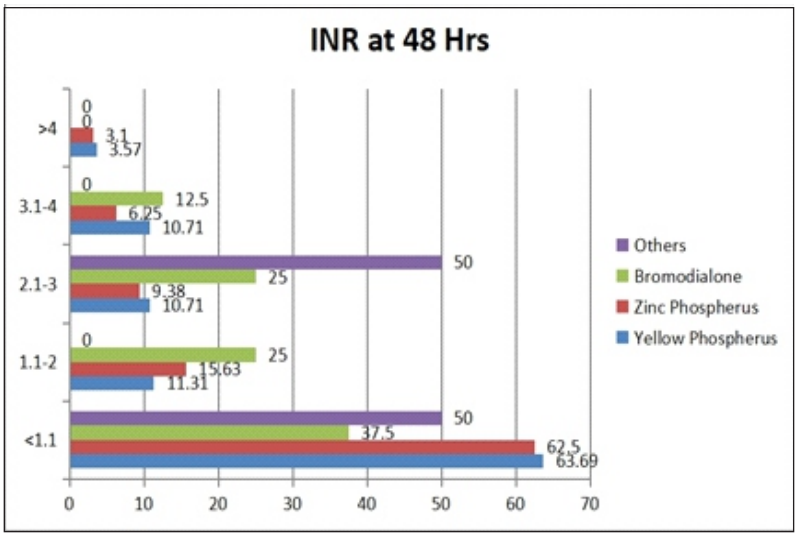

Figure 5: Distribution of Patients According to INR at 48 Hours After Admission

The data shows a statistically significant variation in INR levels across different types of rodenticide poisoning. In yellow phosphorous poisoning cases, most patients (107) had an INR <1.1, with fewer patients showing progressively higher INR levels. For zinc phosphide poisoning, a majority (20) also had INR <1.1, though some had higher INR values. Bromadiolone poisoning displayed a more even distribution across INR levels, with fewer patients overall. This distribution indicates significant differences in coagulation profiles among the poisoning types ($p < 0.0001$).

Table 1: Distribution of Patients According to Liver Function Test

Rodenticide	Normal LFT		Abnormal LFT	
	N	%	N	%
Yellow Phosphorus	101	48.10	67	31.90
Zinc Phosphide	25	11.90	7	13.33
Bromadiolone	0	0.00	8	1.9
Others	0	0.00	2	0.95
Total	126	60.00	84	40.00
P value	<0.0001			

The table shows the distribution of liver function test (LFT) results among patients with different types of rodenticide poisoning. A majority of yellow phosphorus poisoning cases had normal LFTs (48.1%), while a notable percentage (31.9%) had abnormal LFTs. Bromadiolone . poisoning had the highest rate of abnormal LFTs (100%), and the overall difference in LFT results across poison types was statistically significant ($p < 0.0001$), indicating that liver function is variably affected depending on the type of poison ingested

Table 2: Outcome of Patients in Hospital

Rodenticide	Outcome			
	Recovered Without Complications	Recovered With Complications	Died	Total
	N (%)	N (%)	N (%)	N (%)
Yellow Phosphorus	51(30.0)	101(60.0)	16(10.0)	168(100.0)
Zinc Phosphide	8(25.0)	16(50.0)	8(25.0)	32(100.0)
Bromodialone	6(75.0)	2(25.0)	0(0.0)	8(100.0)
Others	1(50.0)	1(50.0)	0(0.0)	2(100.0)
Total	66(31.42)	120(57.14)	24(11.43)	210(100.0)
P Value	<0.0001			

In cases of yellow phosphorous poisoning, 51 patients recovered without complications, 101 recovered with complications, and 16 died. Among those with zinc phosphide poisoning, 8 patients recovered without complications, 16 recovered with complications, and 8 died. For bromadiolone poisoning, 6 patients recovered without complications, 2 recovered with complications, and no deaths were recorded. Overall, across all types of poisoning, 66 patients recovered without complications, 120 recovered with complications, and 24 patients died, highlighting varying outcomes based on the type of poison ingested.

Table 3: Outcome of Patients in Hospital

Complication	Yellow Phosphorus	Zinc Phosphate	Bromodialone	Others	Total
	N (%)	N (%)	N (%)	N (%)	N
INR Without Haemorrhage	7(19.44)	3(9.38)	6(75.0)	1(50.0)	17
INR With Haemorrhage	10(27.78)	5(15.63)	2(25.0)	1(50.0)	18
Acute Hepatitis	11(30.56)	4(12.50)	0(0.00)	0(0.00)	15
Hepatic Encephalopathy	6(16.67)	3(9.38)	0(0.00)	0(0.00)	9
Myocarditis	0(0.00)	7(21.88)	0(0.00)	0(0.00)	7
Arrhythmias	0(0.00)	1(3.13)	0(0.00)	0(0.00)	1
ARDS	2(5.56)	0(0.00)	0(0.00)	0(0.00)	2
Hypotension	0(0.00)	9(28.13)	0(0.00)	0(0.00)	9
Total	36(100)	32(100.0)	100(100.0)	100(100.0)	78
P Value	0.04				

The table outlines complications among patients with various types of rodenticide poisoning. Bromadiolone poisoning had a high rate of INR complications, mostly without hemorrhage (75%), while yellow phosphorus poisoning showed varied complications, including acute hepatitis (30.56%) and hepatic encephalopathy (16.67%). Zinc phosphate cases frequently presented with hypotension (28.13%) and myocarditis (21.88%), showing statistically significant differences in outcomes across poison types (p = 0.04).

Table 12: Comparison of Time Delay in Presentation to Hospital and their Outcomes

Duration	Time Delay to Present to Hospital in Hours					
	0-2 Hours	2-6 Hours	6-12 Hours	12-24 Hours	>24 Hours	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Recovered without complication	27(40.91)	20(30.30)	10(15.15)	7(10.61)	2(3.03)	66(100.0)
Recovered with complication	48(40.0)	35(29.17)	17(14.17)	12(10)	8(6.67)	120(100)
Died	0(0.0)	5(20.83)	0(0.00)	0(0.00)	19(79.17)	24(100.0)
Total	75(35.71)	60(28.57)	27(12.86)	19(9.05)	29(13.81)	210(100.0)
P value	<0.0001					

The table shows that early hospital presentation significantly impacts patient outcomes in rodenticide poisoning cases. Among those presenting within 0-2 hours, none died, with 40.91% recovering without complications. Conversely, 79.17% of patients who presented after more than 24 hours died, indicating a statistically significant correlation ($p < 0.0001$) between delayed presentation and higher mortality.

DISCUSSION

To eliminate rodents, people commonly use compounds known as "rat poisons" or rodenticides, which rank among the most hazardous substances typically present in households. While toxic metals like arsenic were historically used to control rodent populations, anticoagulants have become the most prevalent type of rodenticide in the twenty-first century. This overview outlines the methods for diagnosing and managing various forms of rodenticide poisoning, underscoring the importance of a multidisciplinary approach in treating cases of rodenticide exposure. Accordingly, this study was conducted to analyze the clinical characteristics of patients admitted with rodenticide poisoning to the General Medicine Department at McGann Tertiary Care Hospital and to evaluate the outcomes and mortality rates associated with different rodenticides.

In our study, we found that the majority of participants (48.10%) were aged 21-30 years, followed by 30% in the under 20 age group, with a mean age of 25.84 ± 8.75 years. Among the 210 participants, 90% were male and only 10% were female, with a significant proportion (58.6%) being unmarried. Notably, the predominant reason for poisoning was suicidal intent, accounting for 99% of cases. The time from poisoning to hospital presentation was typically within 2 hours for 35.71% of patients, followed by 28.5% presenting between 2-6 hours. The most frequently used rodenticide was yellow phosphorus (80%), followed by zinc phosphide (16%). In alignment with our findings, Kanchan T et al. (2008) reported mean ages of 40.5 years for males and 34.4 years for females in their study. Similarly, Albano GD et al. (2022) noted that 71.7% of suicidal poisoning cases involved males. Furthermore, Abhilash KP et al. (2019) identified rodenticide as the most common cause of suicidal poisoning, echoing our results [14-15].

In our study of 210 participants, the majority (90%) were normotensive, with none exhibiting hypertension, and 10% presenting with hypotension. Additionally, 97.62% of participants had a normal pulse rate, while only 5 showed tachycardia. Similar findings were reported by Lee HL et al. (2008) and Vyas D et al. (2013), where only a few cases experienced tachycardia, aligning with our observations [16-17].

In our study, we observed a clear relationship between the time of hospital presentation and patient outcomes. Among the 75 patients who arrived at the hospital within 2 hours of poisoning, none succumbed; instead, 48 recovered with complications, and 27 recovered without any complications. For those arriving between 2-6 hours post-ingestion, 5 patients died, while 20 recovered without complications, and 35 recovered with complications. Notably, of the 29 patients who presented after more than 24 hours, the majority (19) did not survive. This statistically significant difference highlights the critical importance of timely medical intervention in cases of rodenticide poisoning. Similar findings have been reported in previous studies. For instance, Finkelstein Y et al. (2015), Nordentoft M et al. (1993), and HL et al. (2008) observed that patients who presented to the hospital in the early hours after poisoning had higher survival rates, while those with suicidal poisoning who delayed seeking medical care faced a higher risk of mortality. This trend underscores the life-saving potential of rapid hospital admission in cases of acute

poisoning and aligns closely with the outcomes observed in our study [18-19].

In this study, the majority of participants (48.1%) were in the 21-30 age group, followed by 30% who were under 20 years old, with a mean age of 25.84 ± 8.75 years. Of the 210 participants, 90% were male and 10% were female, and most (58.6%) were unmarried. The primary reason for poisoning was suicidal intent, accounting for 99% of cases. The time from poisoning to hospital arrival was within 2 hours for 35.71% of patients, followed by 28.5% who arrived between 2-6 hours. The most commonly used rodenticide was yellow phosphorus (80%), followed by zinc phosphide (16%).

CONCLUSION

Rodenticide poisoning is an important health problem with a high case fatality rate especially with metal phosphides. Easy availability, over the counter or on e-commerce websites, and a lack of antidotes for rodenticides in our country pose an important health problem. Improving public awareness regarding their lethality and strict monitoring of sales and usage of rodenticides could help to avoid indiscriminate use and poisoning.

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